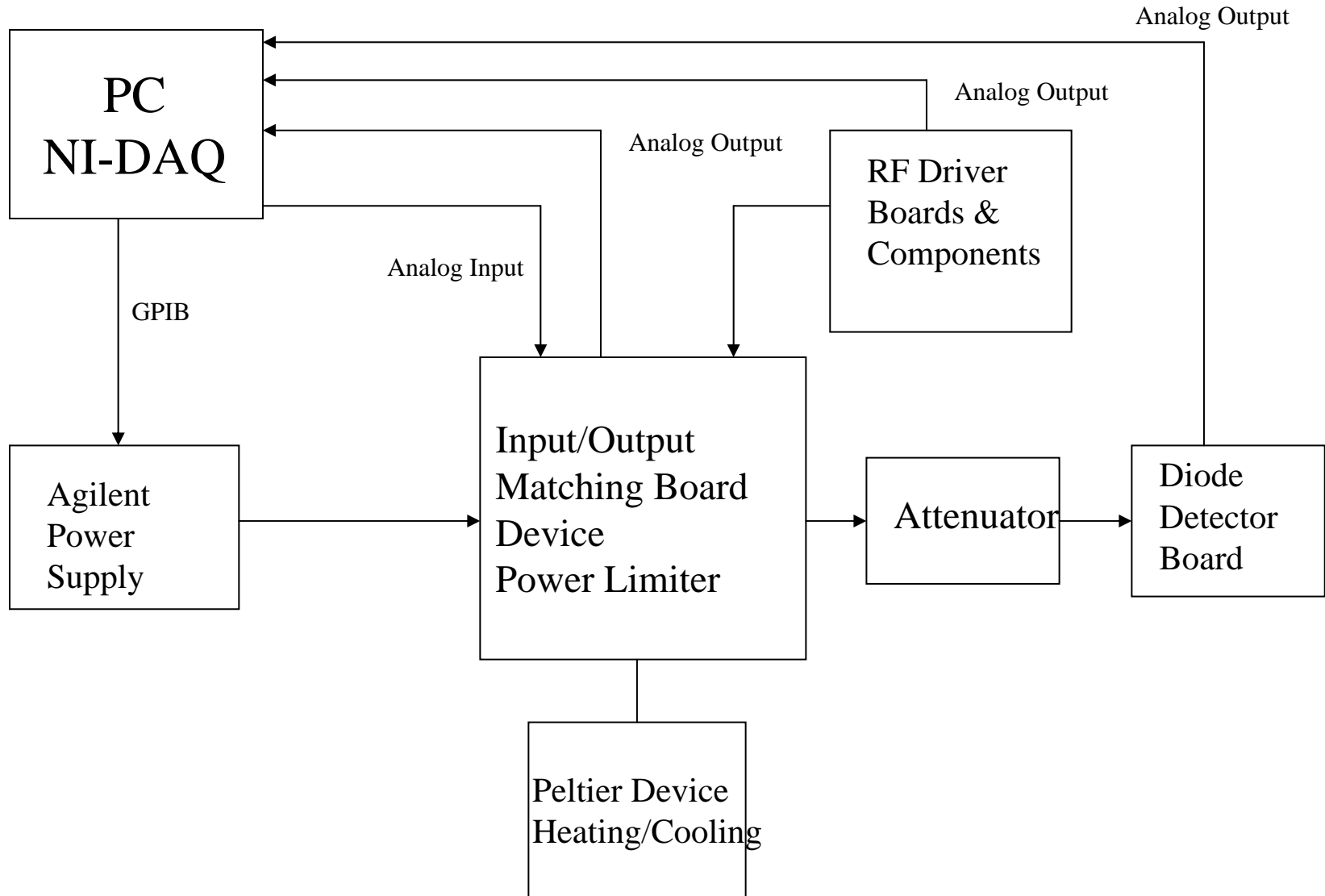
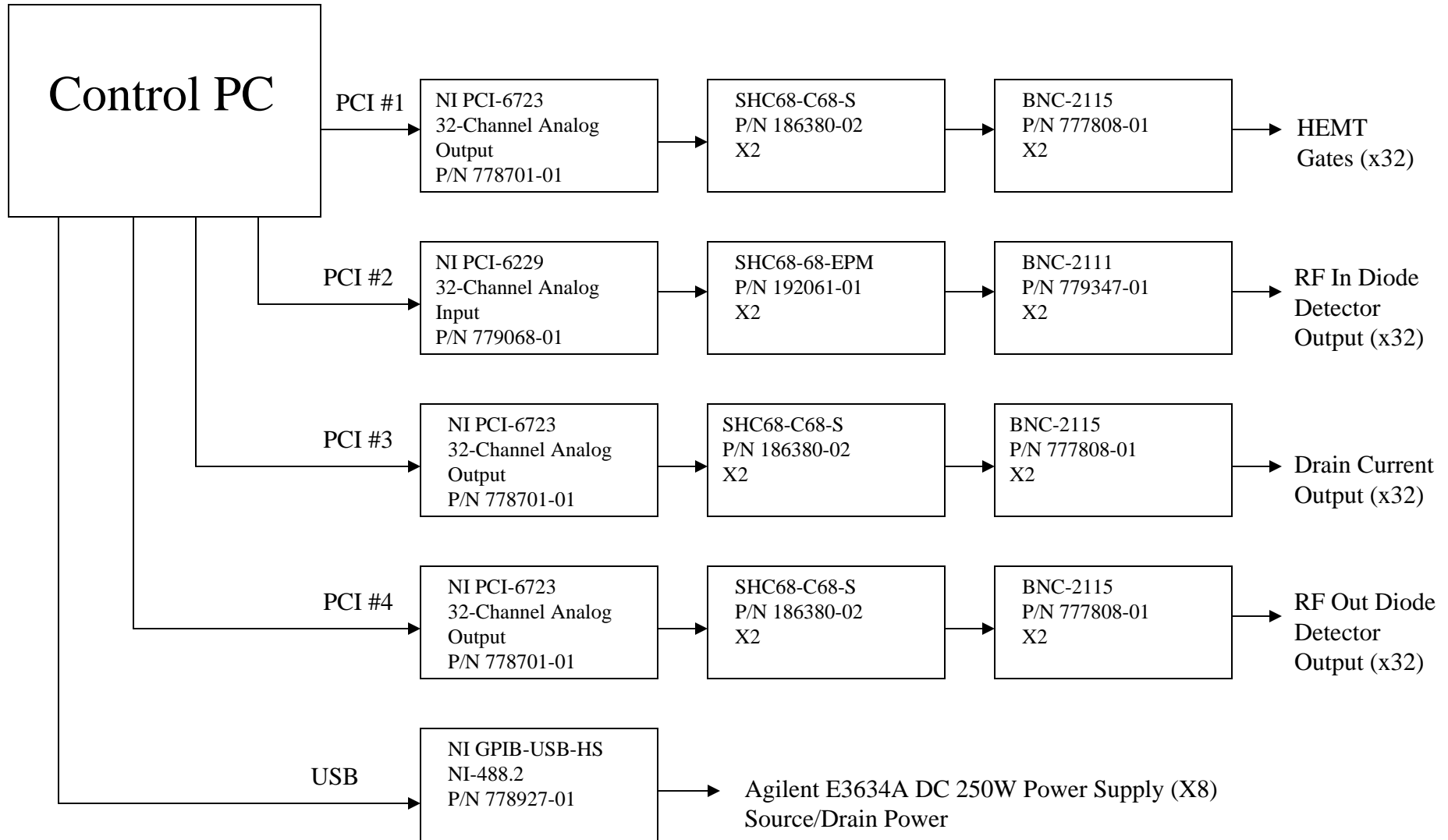


RF Reliability Test Stand

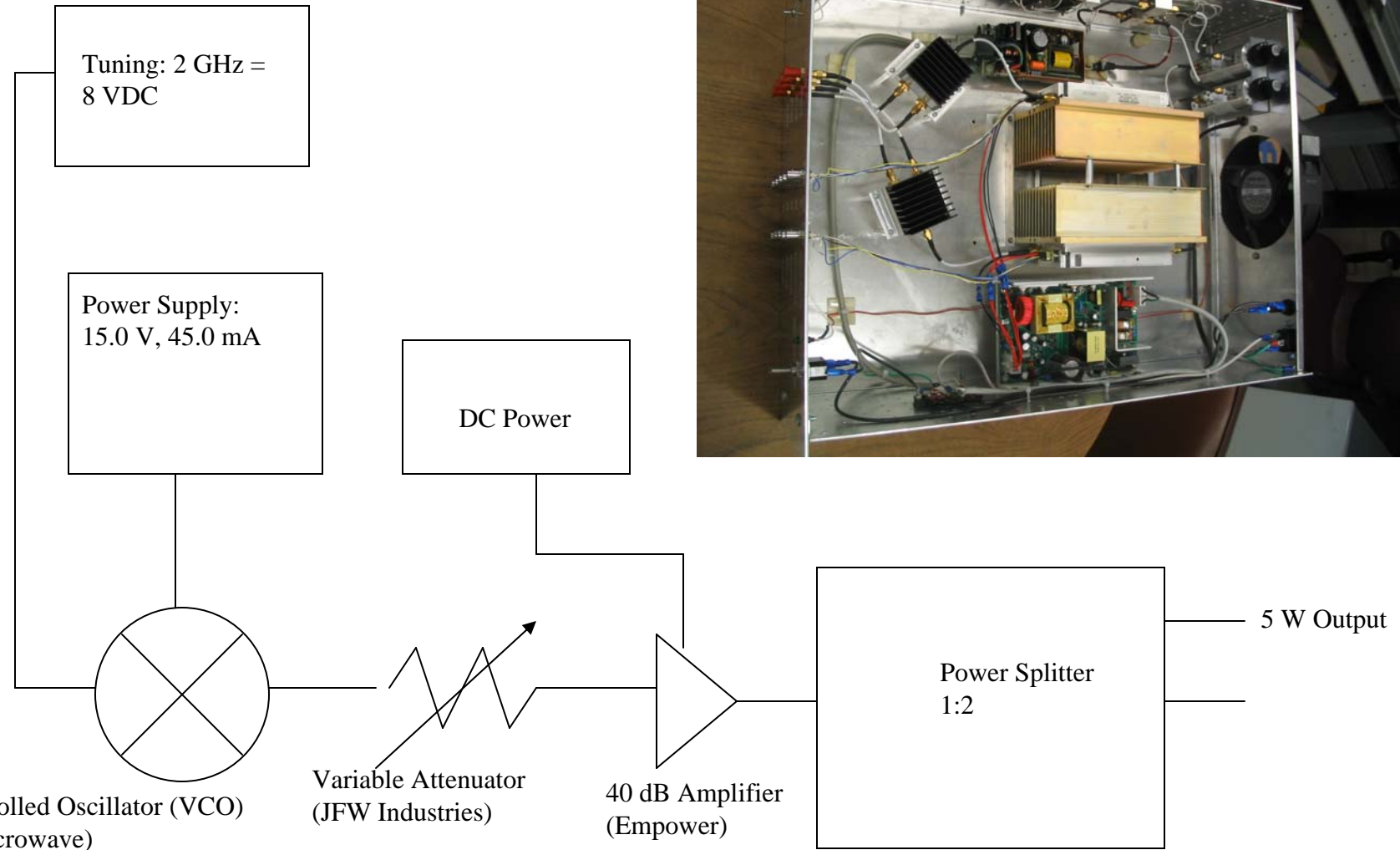


LabView Control Environment

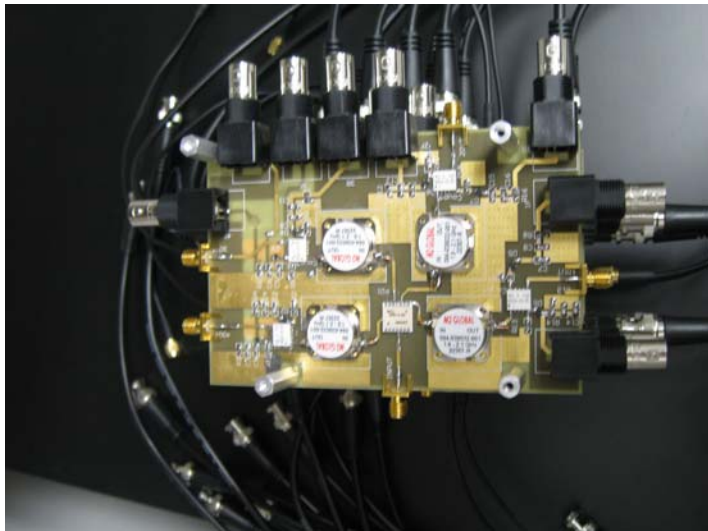
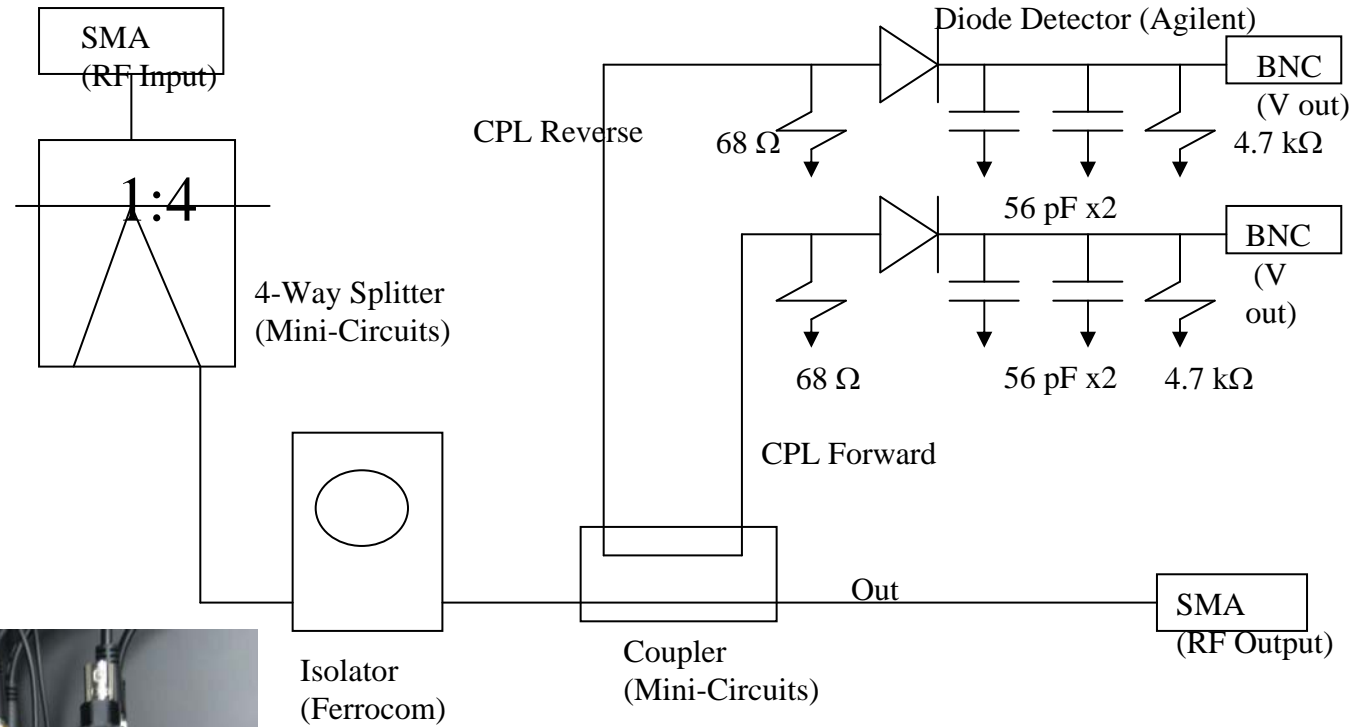
PC I/O DAQ



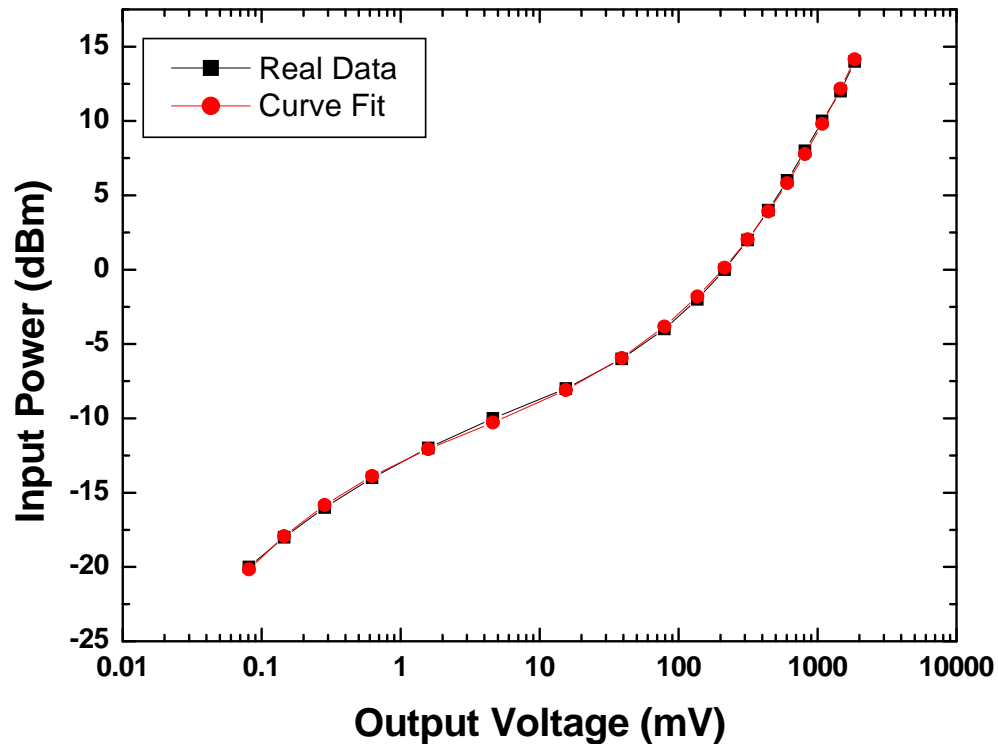
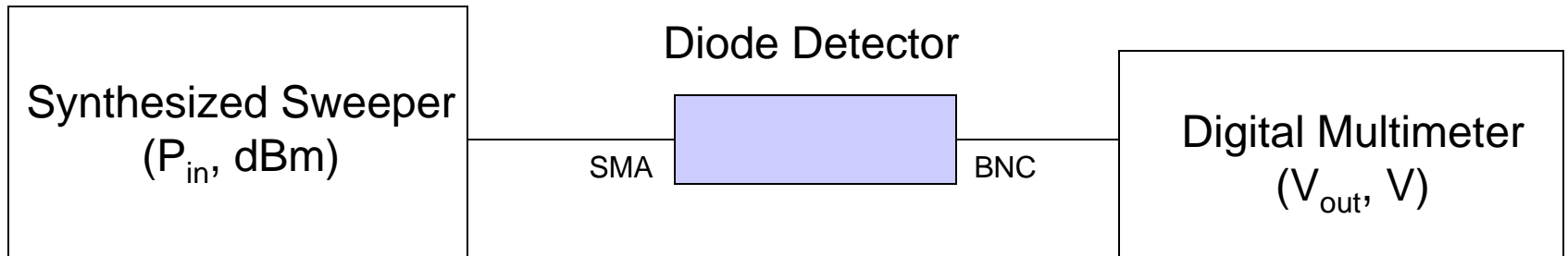
RF Power Supply (x4)



RF Splitter Board Detail (x8)

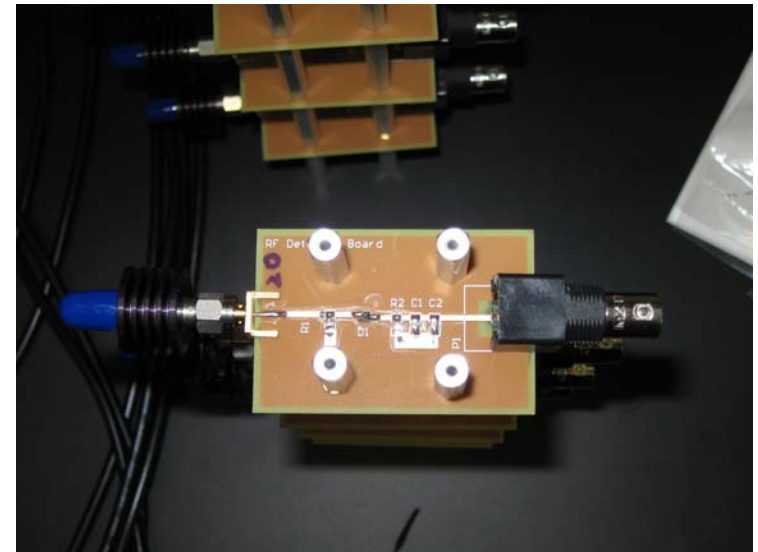


Detector Board Characterization

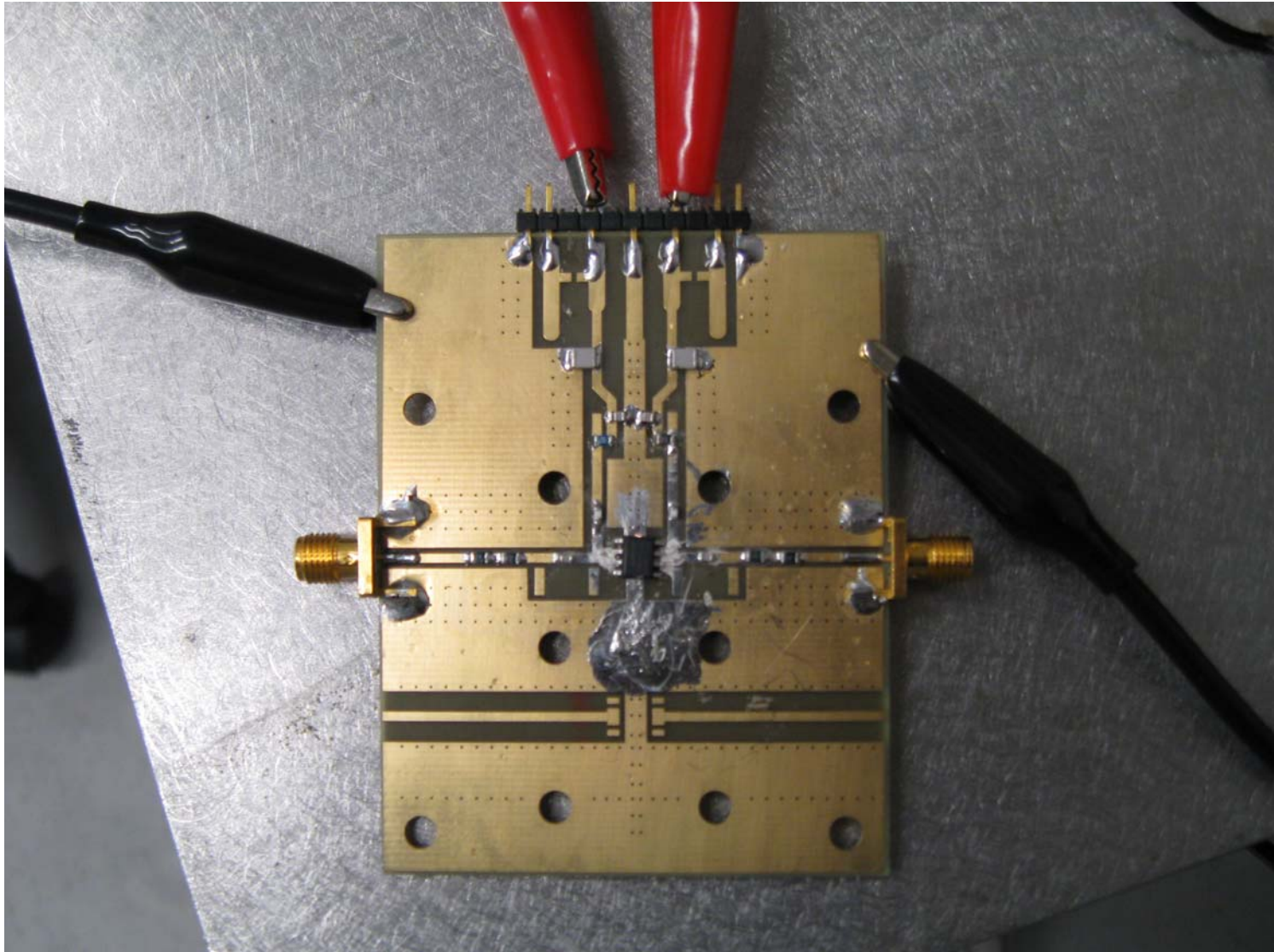


At 2 GHz:

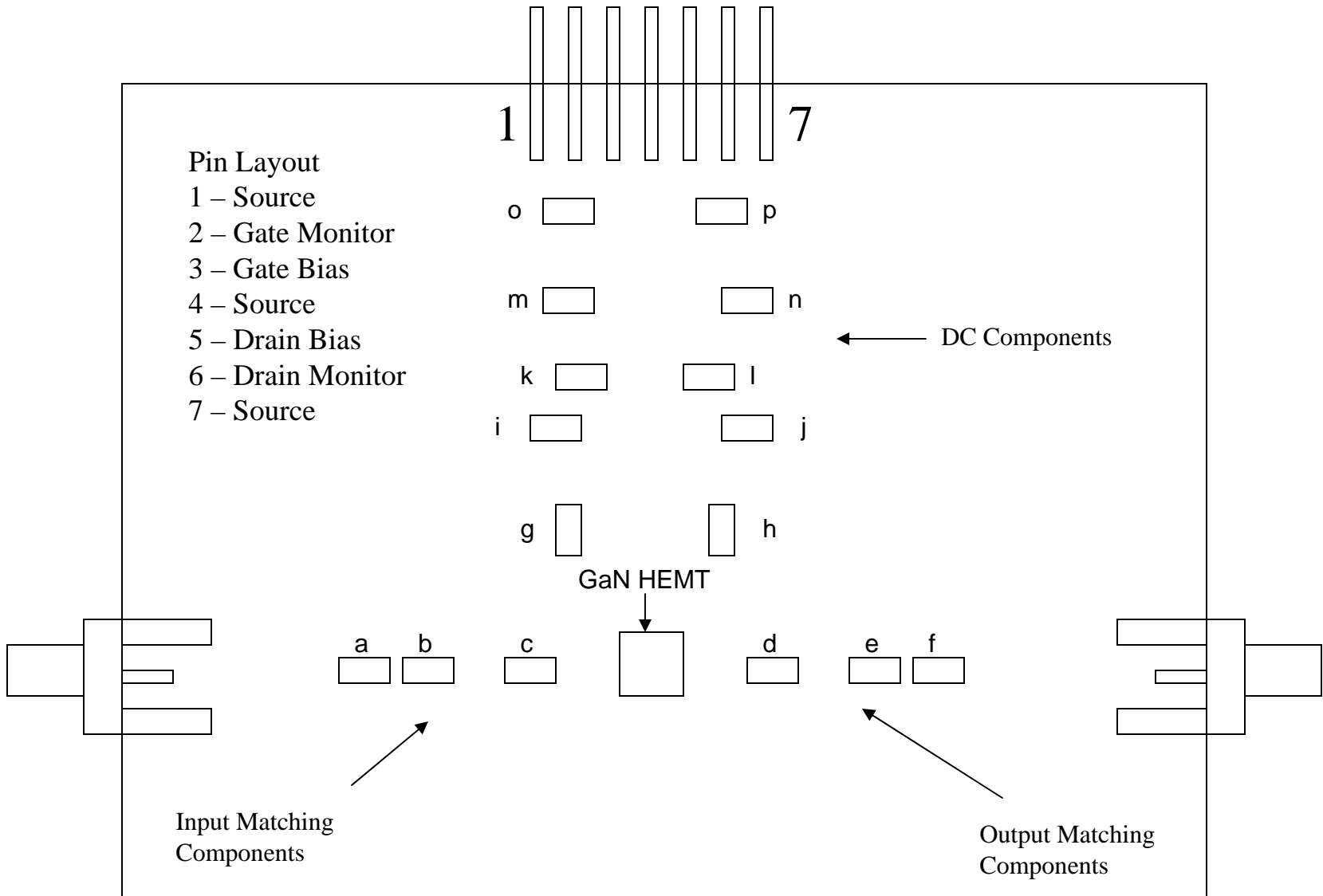
$$P = a[\ln(bV)]^3 + c[\ln(bV)] + d$$



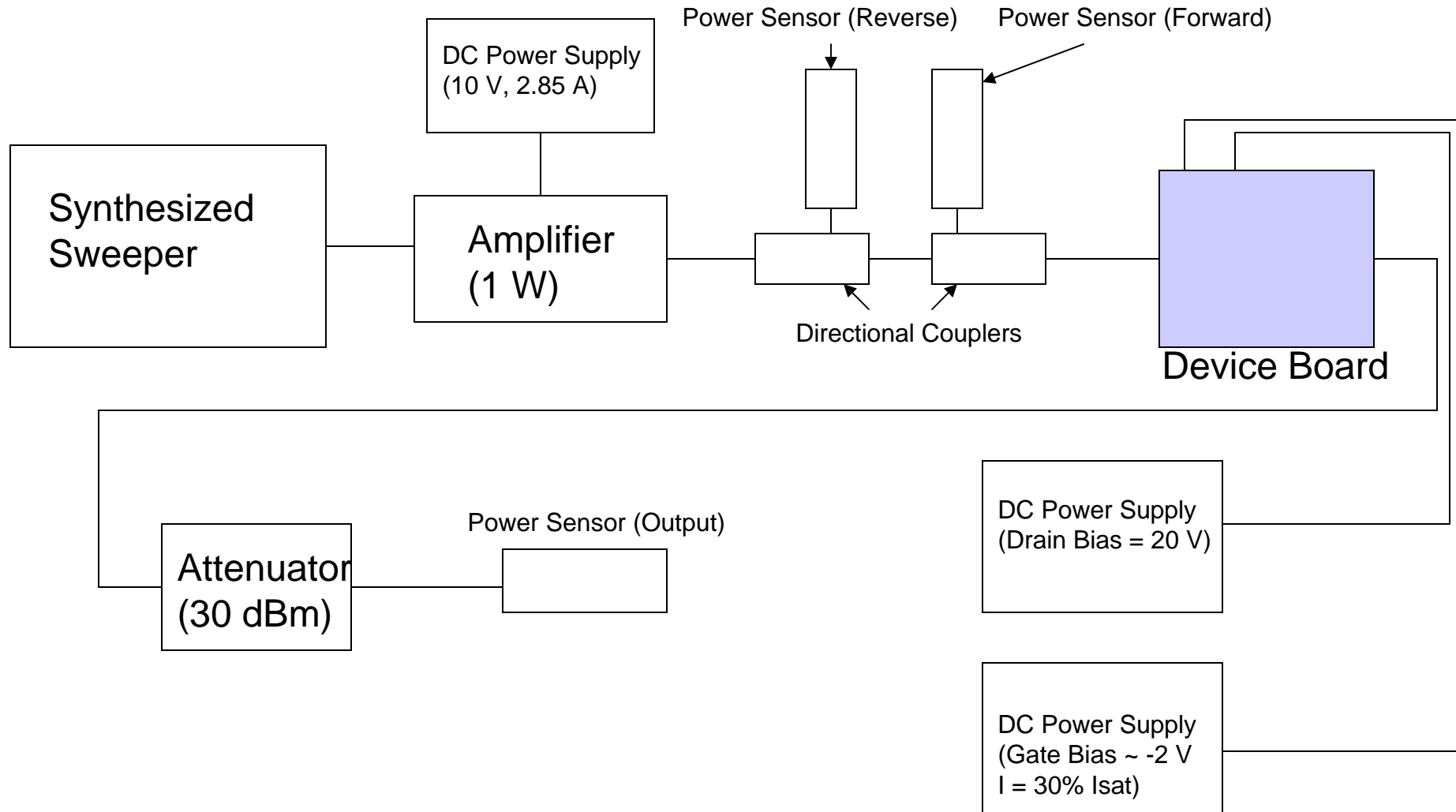
Device Board Photos



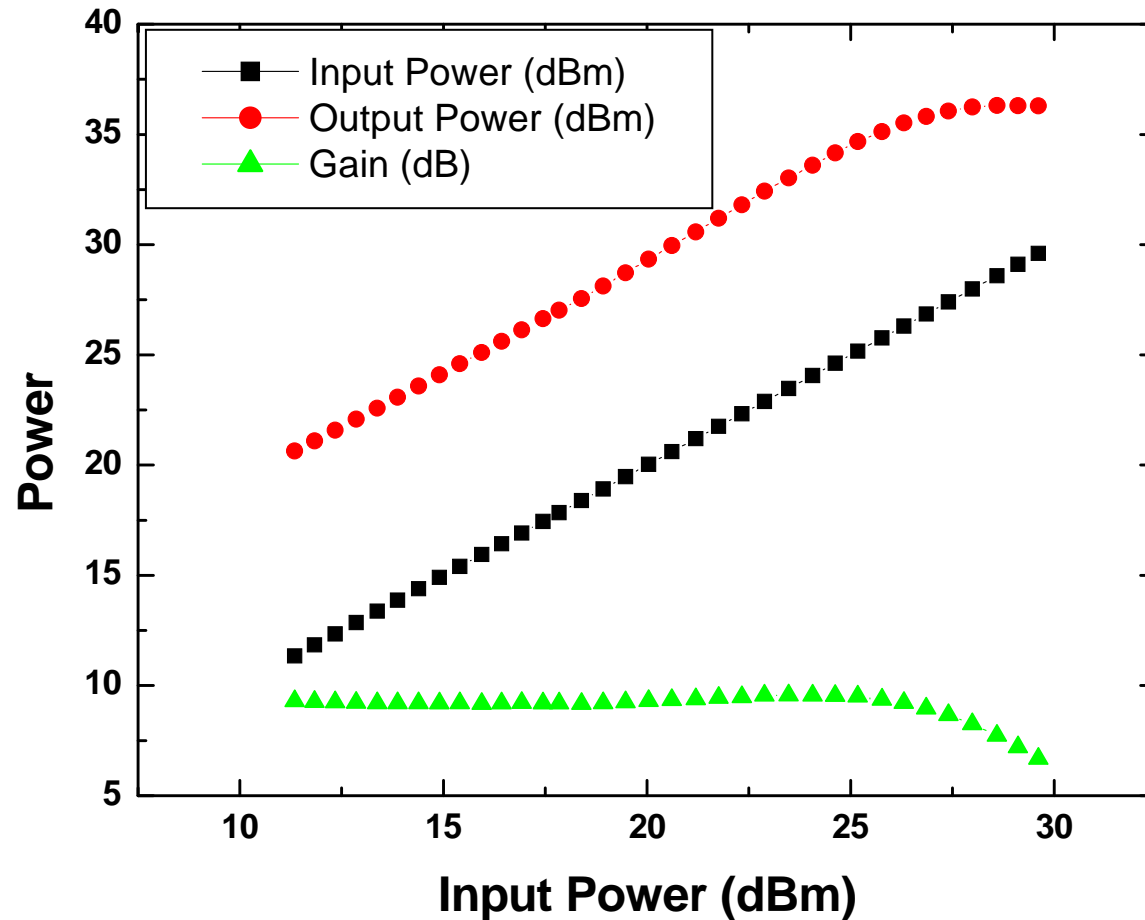
Device Board Layout



Device Board Characterization



1.2 mm GaN HEMT Power Characterization



Master System Monitor

1	PS 1 ▾	2	PS 1 ▾	3	PS 1 ▾	4	PS 1 ▾
5	PS 2 ▾	6	PS 2 ▾	7	PS 2 ▾	8	PS 2 ▾
9	PS 3 ▾	10	PS 3 ▾	11	PS 3 ▾	12	PS 3 ▾
13	PS 4 ▾	14	PS 4 ▾	15	PS 4 ▾	16	PS 4 ▾
17	PS 5 ▾	18	PS 5 ▾	19	PS 5 ▾	20	PS 5 ▾
21	PS 6 ▾	22	PS 6 ▾	23	PS 6 ▾	24	PS 6 ▾
25	PS 7 ▾	26	PS 7 ▾	27	PS 7 ▾	28	PS 7 ▾
29	PS 8 ▾	30	PS 8 ▾	31	PS 8 ▾	32	PS 8 ▾

STOP ALL

Iteration Time (ms) [DEBUG]
482

Color Reference

- Device Operating Within Spec
- Device within 5 % of Failure
- Device Failed / Channel Deactivated
- Test Completed / Time Expired
- Channel Not in Use

Power Supply Output Voltages

PS 1 Voltage (V)	0	PS 5 Voltage (V)	0
PS 2 Voltage (V)	0	PS 6 Voltage (V)	0
PS 3 Voltage (V)	0	PS 7 Voltage (V)	0
PS 4 Voltage (V)	0	PS 8 Voltage (V)	0

Power Supply 1

Amp 1

- ALC On
- ALC Mute
- Level 0%

Amp 2

- ALC On
- ALC Mute
- Level 0%

Power Supply 2



Amp 1


- ALC On
- ALC Mute
- Level 0%

Amp 2


- ALC On
- ALC Mute
- Level 0%

Single Device Monitor

On / Off





Start

Data File
C:\Testrun.xls 


Test Mode **Constant Drain/Collector**

Autosave Every 1 Hours

Wafer Name / Batch Descriptor
eb3242
Part Prefix Part Number
NT 0001
Performed By
Torben F.

Comments

Maximum Experiment Duration
1 Hours
Time Elapsed
0:00:00:00
Stress Mode Present Stress Level
Normal 100 %

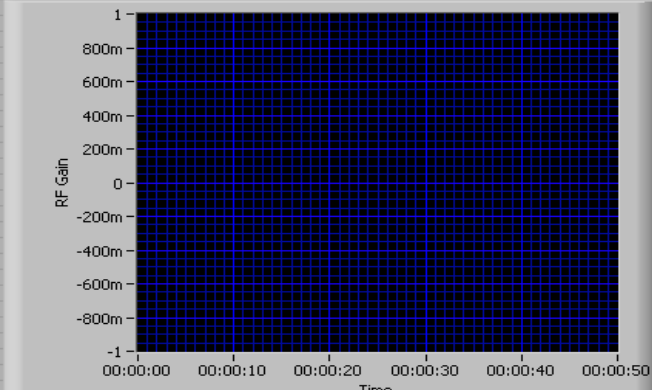
Failure Level 0 %
Samples Past Fail 5
Attenuator connected?


Gate/Base Monitor Resistor 0 ohms
Gate/Base Control Voltage 0 V
Gate/Base Control Current Inf A
Gate/Base Monitor Voltage 0 V
Gate/Base Monitor Current Inf A
Gate/Base Voltage (Vbe) 0 V
Drain/Collector Supply Voltage 0 V
Drain/Collector Voltage (Vce) -51.5804m V
Drain/Collector Monitor Resistor 100m ohms
Drain/Collector Ext Resistance 0 ohms
Drain/Collector Control Current 0 A
Drain/Collector Monitor Current 515.804m A
Drain/Collector Monitor Voltage 51.5804m V
Control Voltage Start -4 V
Splitter Forward Power NaN dBm
Splitter Reverse Power NaN dBm
Detector Output Power NaN dBm

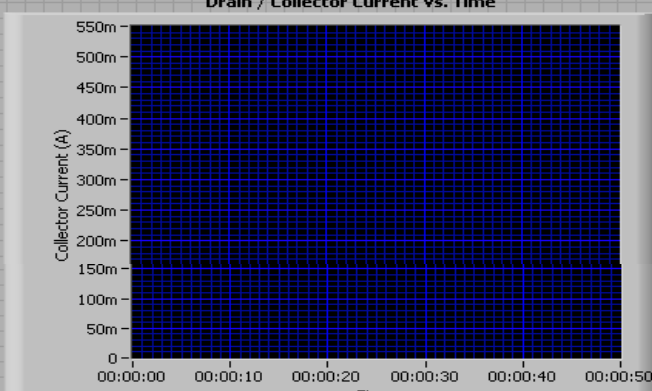
Sample Time Intervals

	Initial Sample Rate (t1)		
After	1	Hours	5
	1	Hours	5
	1	Hours	5
	1	Hours	5

Clear/Reset Settings Save Data Now Plot Buffer Size 200


RF Gain vs. Time

RF Gain Max 0 A RF Gain Median NaN A

Drain / Collector Current vs. Time

Drain/Collector Max (I) 0 A Drain/Collector Median (I) NaN A

Single Device Monitor

On / Off 

Data File: C:\Testrun.xls

Test Mode: Constant Drain/Collector

Autosave Every: 1 Hours

Wafer Name / Batch Descriptor: e33242

Part Prefix: NT Part Number: 0001

Performed By: Torben F.

Comments:


Maximum Experiment Duration: 1 Hours

Time Elapsed: 0:00:00:00

Stress Mode: Normal Stress Level: 100 %

Failure Level: 0 %

Samples Post Fail: 5

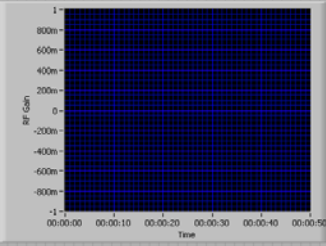
Alternator connected? 

Sample Time Intervals

Initial Sample Rate (t1)	After
1 Hours	5 sec
1 Hours	5 sec
1 Hours	5 sec
1 Hours	5 sec
1 Hours	5 sec

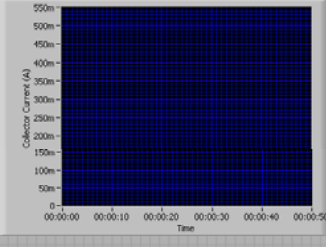
Clear/Reset Settings Save Data Now Plot Buffer Size: 200 Drain/Collector Max (I): 0 A Drain/Collector Median (I): NaN A

RF Gain vs. Time



RF Gain Max: 0 A RF Gain Median: NaN A

Drain / Collector Current vs. Time



Drain/Collector Max (I): 0 A Drain/Collector Median (I): NaN A

Debug Use Only

Status: Off

Stress Values

Base Stress Voltage (V): 0

Base Stress Current (A): Inf

Test Parameters

Test Mode: Constant Collector

Time Elapsed at Save: 0:00:00:00

Experiment Duration: 1 Hours

Base Current Maximum: 0

Base Current Median: Inf

Base Control Voltage: 0

Base Control Current: Inf

Base Monitor Resistor: 0

Collector Current Maximum: 0

Collector Current Median: 0.44072

Collector Supply Voltage: 0

Collector Control Current: 0

Collector Monitor Resistor: 0.1

Collector Exit Resistance: 0

Splitter Forward Power: NaN dBm

Detector Output Power: NaN dBm

RF Source and Temperature Controller

System Images

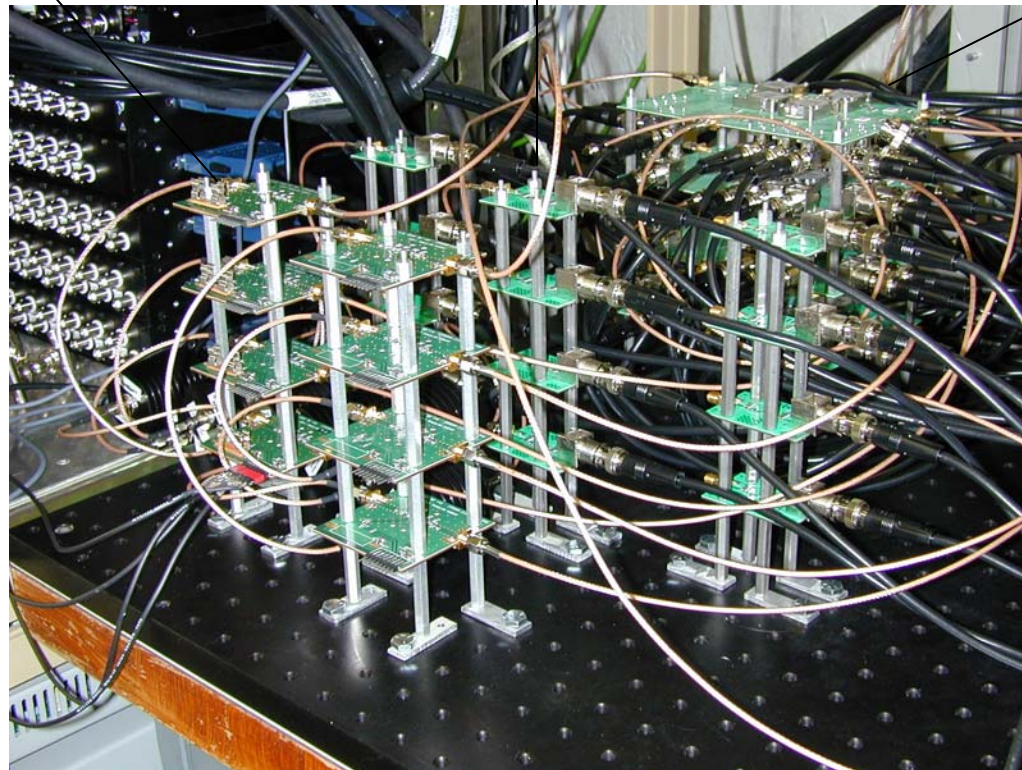


System Photo

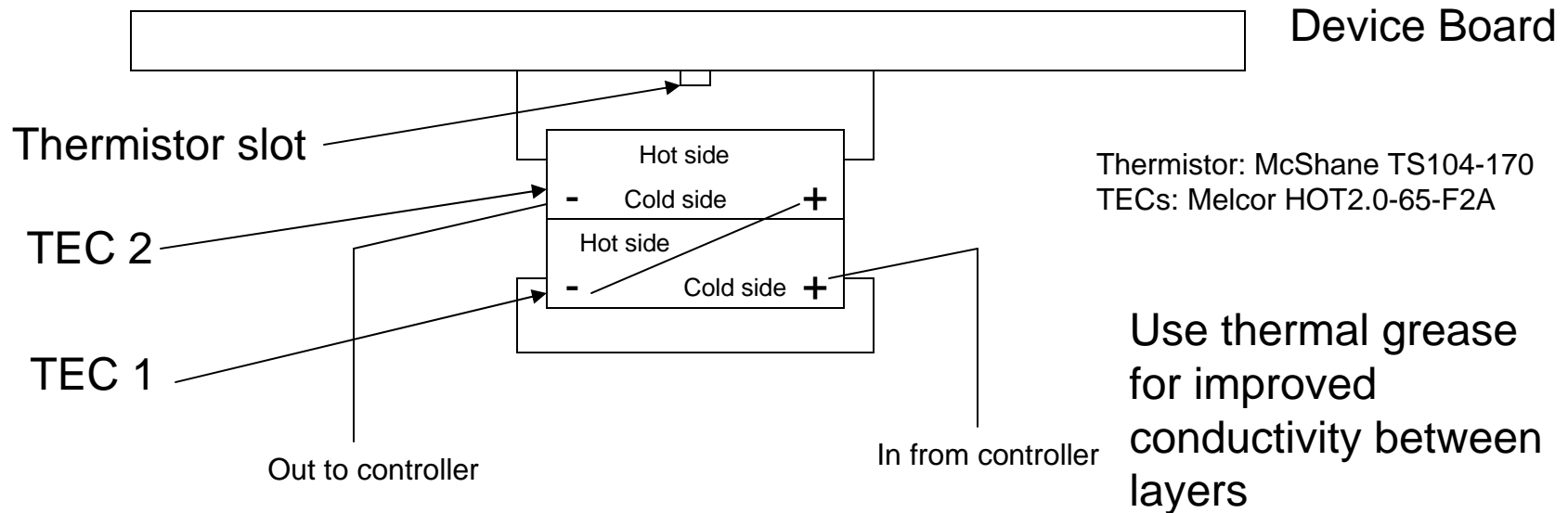
Detector Diodes (12)

Device Boards (8)

Splitter Boards (4)



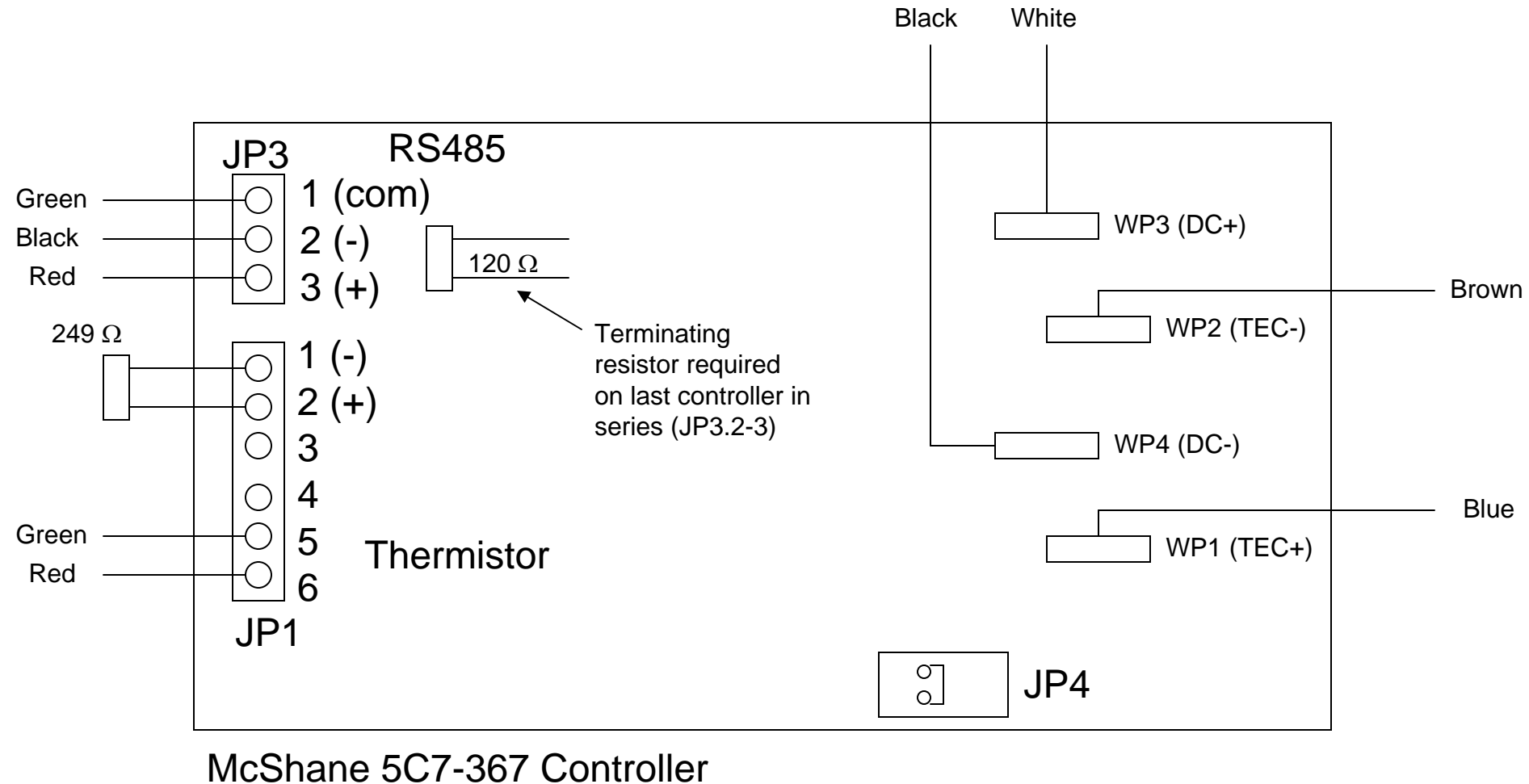
Heater Setup and Tuning



Notes on tuning a PID controller

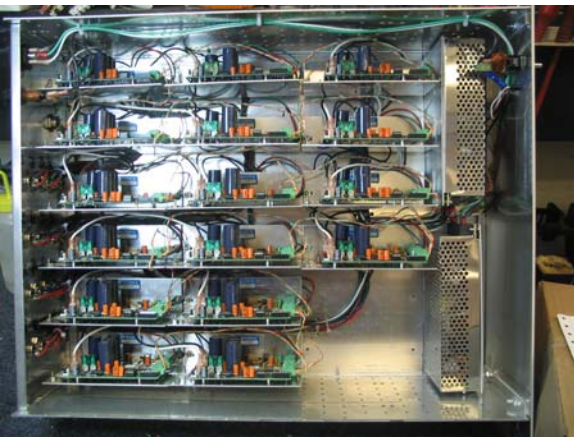
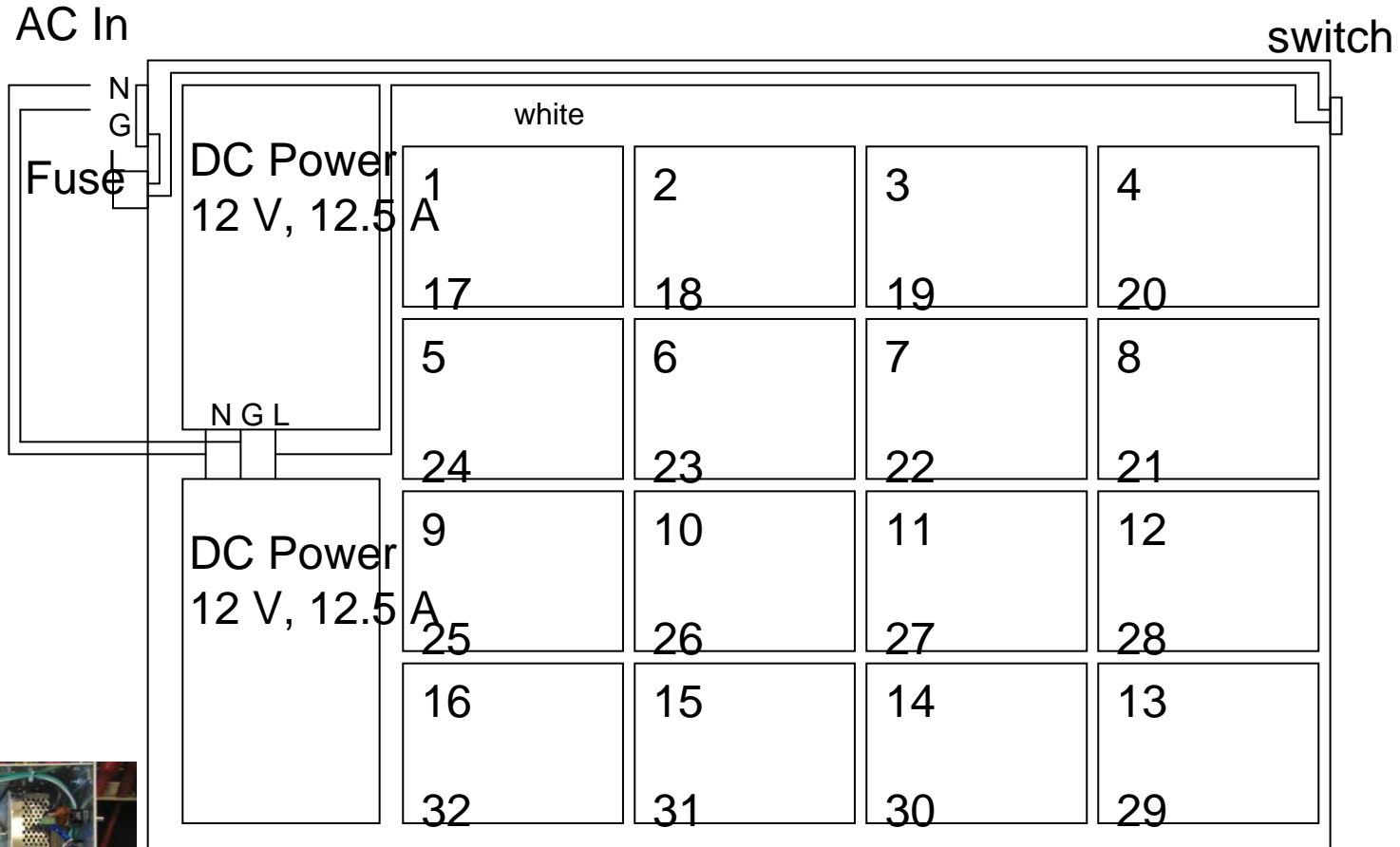
- Start with default values ($P=20$, $I=0$, $D=0$), turn on output at desired setpoint (100 or 125 C would be good)
- If controller reaches set point in a reasonable time and does not oscillate, do nothing – most tuning is required either to compensate for droop or oscillation, or to alter the approach to the set point (try to make it sharper, or eliminate overshoot)
- To tune controller, decrease P until temperature begins to oscillate, note period of oscillation – this is purely proportional control, and you have pushed the system to an instability
- Now increase I , an ideal value should be half the period of oscillation – this integrates the error signal over time to compensate for droop
- Now increase D , an ideal value should be $I/10$ – this takes the rate of change of the temperature into account, and is typically used to eliminate overshoot or on very fast or slow systems

PID Controller Layout



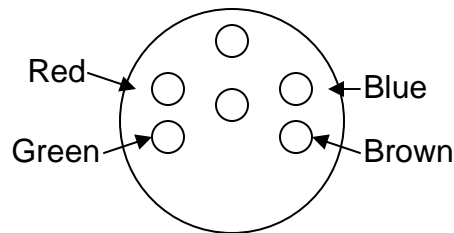
Note: By shorting JP1.1 to JP1.4, the controller address will become 99 – this can be used to set the addresses of controllers in a loop

Controller Box Diagram

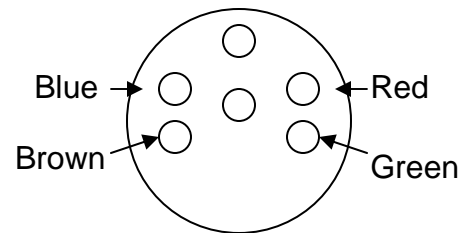


Controller Box I/O Diagram

TEC/Thermistor – 6 pin DIN connector



Inside Box



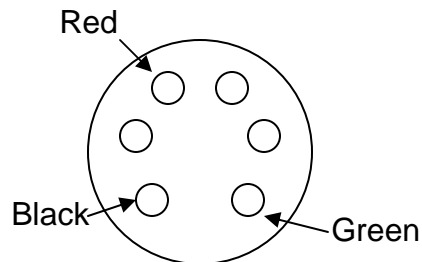
Outside Plug

Status:

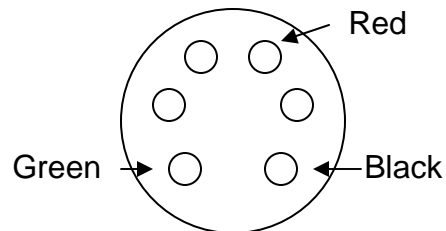
Incomplete

(parts are in the boxes under the table the controller boxes are on)

RS485 – 6 pin mini-DIN connector



Inside Box



Outside Plug

Note: current RS485 connection is hard wired to the controllers through holes in the boxes – the scenario shown on the left would be an ideal case, but I have not gotten it to work (either poor soldering job or the connectors alter the characteristic impedance of the loop so that it no longer matches the terminating resistor (120 ohm))

Controller Software (single)

Set point (input temperature, click "Send Box Values" to change)

Proportional = temp range around which directly proportional control is applied (set where system just begins to oscillate)

Integral = $\frac{1}{2}(\text{period of oscillation})$
Derivative = Integral/10

Temperature band where controller is activated by temperature change

Compensates for differences between Thermistor(s) and actual temperature
Multiplier compensates for asymmetric response of TEC between heat and cool

RS232 Port (set to COM1)

Address=1-32, 0=all, 98=default for new

Box must be checked when addressing nonzero controller

Click to begin communications with controllers

Measured Temperature

Set point (from tuning box)

Percentage of max output power

Click to start/stop sampling (button flashes when sampling)

Output pulse width

Set point input

Control type must be PID without reference temp

Direction of current flow in TEC for heating

Fixed value alarm is preferred to rate of change

Output power is disabled at alarm condition

Enables output power

Alarm must be manually cleared before resuming output

Actual controller address

Alarm sensor (irrelevant without second thermistor)

Temperature units